



The *Bagua* as an Intermediary between Archaic Chinese Geomancy and Early European Urban Planning and Design

Abraham Akkerman, Jingkun Shao

Department of Geography and Planning, University of Saskatchewan, Saskatoon, SK, Canada

Corresponding author: Abraham Akkerman, Department of Geography and Planning, University of Saskatchewan, Saskatoon, Canada. Email: avi.akkerman@usask.ca

Citation: Akkerman A, Shao J, 2020, The *Bagua* as an Intermediary between Archaic Chinese Geomancy and Early European Urban Planning and Design. *Journal of Chinese Architecture and Urbanism*, 2(1): 968. <http://dx.doi.org/10.36922/jcau.v2i1.968>

ABSTRACT

Present-day concerns with urban design for pedestrians largely surround the issue of microclimate in streetscapes. Such concerns are not new and have been extensively discussed during the European Renaissance. Western historical references on urban design and microclimate primarily converge on a single source: The octagonal, radial-centric plan of an ideal city in Book I of the *Ten Books of Architecture* written in the late first century BCE by Marcus Vitruvius Polio. As his own source Vitruvius pointed to the Tower of the Winds in Athens, designed c. 50 BCE by Andronicus of Cyrrhus on an octagonal plan, respectful of eight wind directions. We posit that octagonal *Bagua* geomantic map made its way from Chang'an in China to Cyrrhus in western Asia during the first century BCE, and was possibly one of two sources that stirred Andronicus toward his design of the tower, the other source being the Pharos Lighthouse in Alexandria. The *Bagua* corresponds to the *Luo Shu* magic square that guided the ideal city plan of Han China, while the octagon, through Vitruvius, inspired several city plans in Renaissance and Baroque Europe. Beyond the rainbow of multiple impact on Roman urbanism from neighboring civilizations, the ancient Chinese ideal city plan through the intermediary of the *Bagua*, may also have played a role in Vitruvius' own ideal city plan, by way of the Tower of the Winds. The environmental message of the *Bagua*, thus, has possibly carried an indirect impact upon Renaissance and Baroque urbanism, and upon urbanist concerns lasting to this day.

Keywords: ideal city, Han dynasty, *Bagua*, Tower of the Winds, Vitruvius, wind directions

Copyright: Akkerman A and Shao J. This is an open-access article distributed under the terms of the Attribution-Non-Commercial 4.0 International 4.0 (CC BY-NC 4.0), which permits all non-commercial use, distribution, and reproduction in any medium provided the original work is properly cited.

1. INTRODUCTION: THE LITERARY EVIDENCE

The treatise *De architectura*, or *Ten Books of Architecture* ^[1], written over the period 30-20 BCE by the Roman military engineer and architect Marcus Vitruvius Polio (c. 80 BCE – 15 BCE) is the only extant literary source of antiquity that directly addresses architecture and urban design. *De architectura* has been acknowledged as the first in documented Western architectural tradition and literature, and the significance of this book in inspiring the notion of ideal city in later architecture and urban design, has been noted in many studies ^[2]. Conspicuous is the octagonal radial-concentric plan of the Vitruvian ideal city as described in *De architectura*. Since the early Renaissance and up until the seventeenth century, *De architectura* had been an authoritative text, and it is also the octagonal pattern of the Vitruvian ideal city plan that had exerted later influence on the Renaissance model city ^[3]. In spite of doubts concerning the capacity of Vitruvius to explain the ancients' conception of architecture ^[4], the octagonal pattern in numerous ideal city plans inspired by *De architectura* had continued till at least the time of the Plan for London in 1666 by Sir Christopher Wren.

De architectura is not necessarily a report on actual architectural and planning practices of the day, but “a disquisition on culture in flux [...] strengthening the bonds between the City and the Roman World” ^[5]. The practice of Roman city planning was based on grid design aligned to the cardinal points. The description of a city plan in *De architectura*, however, deviates from the conventional grid plan practiced by the Romans. In Chapter VI, Book I, Vitruvius describes his octagonal and radial-centric plan, rather than a grid, upon which an ideal city is to be laid out [Figure 1]. A clue to the reason for the difference between actual Roman practice of city planning of the time, and Vitruvius' detailed elaboration of an ideal city plan, rests possibly in the very opening of Chapter VI of Book I:

The town being fortified, the next step is the apportionment of house lots within the wall and the laying out of streets and alleys with regard to climatic condition.

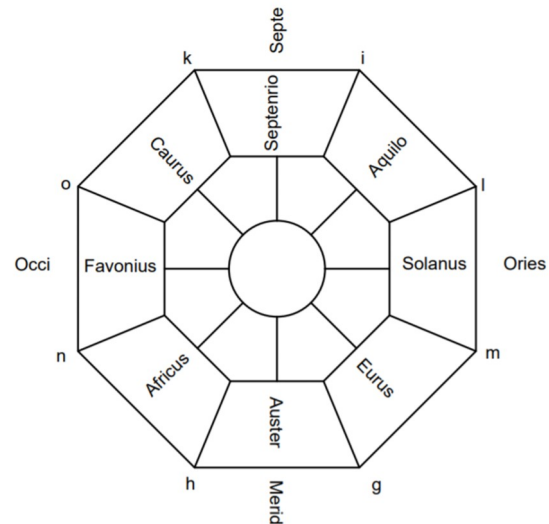


Figure 1. Vitruvius, Plan of an Ideal City, after woodcut by Fra Giovanni Giocondo, 1511 ^[6]

Vitruvius then proceeds with a narrative that describes a plan of an ideal city that addresses the “climatic condition” in terms of wind directions. Thermal comfort in the Mediterranean as most everywhere, is bound to seasons and wind directions. In addition, in the Greco-Roman tradition since at least the time of Hippocrates' book, *On Airs, Waters and Places* (400 BCE/1881) ^[7], wind directions were believed to impact the health of cities' inhabitants. It appears that Vitruvius' approach was that once the defence needs of the city are ensured, he is free to indulge in articulating his plan for an ideal city addressing the inhabitants' health and thermal comfort. Each wind direction had been represented in the Greco-Roman tradition by a minor deity, and the concern for health and thermal comfort had therefore also some religious implications.

Prior to proceeding with the outline for a city layout addressing wind directions, Vitruvius points to the Tower of the Winds in Athens as the inspiration and conceptual source for his octagonal ideal city plan:

4. Some have held that there are only four winds: Solanus from due east; Auster from the south; Favonius from due west; Septentrio from the north. But more careful investigators tell us that there are eight. Chief among such was Andronicus of Cyrrhus who in proof built the marble octagonal tower in Athens. On the several sides of the octagon he executed reliefs representing the several winds, each facing the point from which it blows [...]

The Tower of the Winds, designed by the Greek astronomer and architect Andronicus of Cyrrhus, and still extant today, was constructed near the Roman Agora in Athens, c. 50 BCE [Figure 2]. Overlooked by the Acropolis and the Parthenon, the marble tower had each of its eight sides face a direction of the compass. From the preceding quote in *De architectura*, however, it seems that eight wind directions were not commonplace at the time; hence the reason for Andronicus to provide a “proof.” On the top of the tower, Vitruvius writes,

[Andronicus] set a conical shaped piece of marble and on this a bronze Triton [Greek god of the sea, the son of Poseidon] with rod outstretched in its right hand. It was so contrived as to go round with the wind, always stopping to face the breeze and holding its rod as a pointer directly over the representation of the wind that was blowing.



Figure 2. Tower of the Winds, painting by Stuart and Revett, 1794 ^[8]

Other than the weathervane in the image of the god Triton, the frieze of the Tower of the Winds was decorated with minor deities in relief, *Anemoi* wind gods representing the winds blowing from the different directions. Identification of the specifically eight wind directions was to successfully address the microclimate of wind currents:

5. Thus Eurus is placed to the southeast between Solanus and Auster; Africus to the southwest between Auster and Favonius; Caurus [...] between Favonius and Serpenterio; and Aquillo between Serpenterio and Solanus. Such, then, appears to have been his device, including the numbers and names of the wind and indicating the directions from which particular winds blow.

Vitruvius then proceeds to advise to utilize amussium, a horizontal wheel showing the direction of the wind, much as the bronze Triton vane on the Tower of the Winds, in laying out the ideal city, presumably on a level ground.

These facts being thus determined, to find the directions and quarters of the winds your method of procedure should be as follows.

6. In the middle of the city place a marble amussium, laying it true by the level, or else let the spot be made so true by means of rule and level that no amussium is necessary.

To align the amussium, much as aligning a sundial, finding the south was necessary. The tower as a meteorological station of sorts, and the first of its kind, had included also a timepiece thanks to which it was called at the time *horologion*. The mechanical *horologion* was a water clock with a supply from the Acropolis above, sheltered inside the structure to record the time when the sun was not shining. Affixed to the sides of the tower were sundials. To Vitruvius the sundial, or at least its gnomon part, were critical to determine compass directions for the planned city.

To adhere to straight lines and equal angles, once the centre of the Vitruvian ideal city has been determined, Vitruvius explains why both a gnomon, the part of a sundial that casts shadow, and a clock, both associated with the Tower of the Winds, are needed:

In the very centre of that spot set up a bronze gnomon or “shadow tracker.” At about the fifth hour in the morning, take the end of the shadow cast by the gnomon, and mark it with a point. From the central point of the space whereon the gnomon stands, as a centre, with a distance equal to the length of the shadow just observed, describe a circle. After the sun has passed the meridian, watch the shadow which the gnomon continues to cast till the moment when its extremity again touches the circle which has been described.

Vitruvius has now identified four points in the plan of his radial-centric ideal city, based on Roman time measurement of the day. Time of the Roman day, measured between sunrise and sunset, was divided into twelve parts, each such part called *horae*. The four points identified in Vitruvius’ approach to founding the ideal city were:

(1) the city’s centre where the gnomon is located,

(2) the first point of the town’s perimeter, and its radius, determined by the end of the shadow cast by the gnomon at the fifth hour,

(3) the second, northernmost point on the city’s perimeter, determined by the intersection of the city’s perimeter and the gnomon’s shadow, or its extension, at the local meridian noon,

(4) the third point of the city’s perimeter, determined by the very end of gnomon’s shadow touching the perimeter. At north Mediterranean latitudes, one hour was about 45 minutes at the winter solstice, and 75 minutes at summer solstice^[9].

2. METHODOLOGY: THE LOGIC OF HISTORIC INQUIRY IN COMPARATIVE URBANISM

Several features of Vitruvius’ ideal city ought to be considered within the territorial context of the Roman Empire at the time. Thus, Vitruvius’ striking radial-centric pattern could be seen previously in the regional plan of Mycenaea, whereby “well-planned radial pattern of built roads covering the immediate hinterland,” converged on Mycenaea as the center^[10].

The circular flair of Vitruvius’ plan, so different from the gridiron practice of Roman planning, may have been inspired by Celtic hillforts in central and western Europe, many of which were disposed on a circular plan^[11]. Furthermore, the very concern with wind directions stems from both Greek urban tradition, represented by Hippocrates of Kos, and the Etruscan attention to environmental conditions throughout Etruria^[12], the geographical setting of the city of Rome during its pre-republican era.

But Vitruvius’ counsel on the ideal city plan cannot go unnoticed when comparing his account also with early Chinese practice for the founding of the capital city that had been recorded in the manual *Kao Gong Ji*, thought to have been written sometime after the first half of the fifth century BCE^[13]:

When the *Jiangren* build the [capital] city, [first,] they use plumb lines and water levels to gauge the flatness of the land; plant a straight pole in the ground and align it with plumb lines; observe and mark the shadows of the pole during the time when the sun rises and sets; draw circles and make it cross the shadows; and then discriminate the east-west direction [from the north-south direction] by [...] consulting the shadow of the pole at noon and the position of the polestar at night.

(Wenren, 2013, p 95–96)^[13]

In contrast with the radial-centric plan of *De architectura*, however, it is the square plan on an orthogonal pattern that is the

result of the procedure for the founding of the ideal city in the ancient Chinese manual. Furthermore, as Wright ^[14] observes, "[t]he division of a city into blocks is implied by the Chinese ritual canons, and cities were so divided at least from the beginning of centralized empire in 221 BCE." Though considerations of geographic latitude, implicit in both procedures, might be legitimately regarded commonplace among ancient surveyors, East and West, the comparison begs a question of certain parallelism in procedures between the ancient Chinese planners, and the Roman architect and engineer.

Evoking comparative urbanism of historic Chinese cities Paul Wheatley ^[15] had alluded to a similar question, pointing out that the square grid plan of the ancient Chinese ideal city "is identical both with that prescribed by [the Biblical prophet] Ezekiel for the city of the Levites ^[16] and with that envisioned by St. John the Divine ^[17]." The orthogonal plan of the Chinese ideal city in the *Kao Gong Ji* has three gates on each of the four sides of the square perimeter, and these are also the features of plans arising from the urbanist visions of both Ezekiel and St. John.

Similitude of the urbanist vision in the *Book of Ezekiel* with the plan in the *Kao Gong Ji* remains an enigma. Separated from China by thousands of kilometers along which menacing deserts and the world's highest mountain ranges pose a forbidding palisade, Ezekiel had sounded his urbanist vision in Babylonia of the sixth century BCE ^[18]. But similarly, parallelism could be sought also between *On Airs, Waters, and Places*, written at the turn of the fourth century BCE, in the admittedly superstitious compendium of beliefs by Hippocrates of Kos on the placement of settlements, and the ancient Chinese geomancy, *Feng shui*, literary, "wind-water," whose medicinal applications are dated to about the same time and later ^[19].

The *Revelation to St. John*, on the other hand, is sourced in place and time to the reign of the Roman emperor Domitian, 81–

96 CE ^[20]. The orthogonal plan in the *Revelation* comes about a century after Vitruvius' *De architectura*, and some two centuries after the founding of a continuous merchant travel route between China and the eastern Mediterranean region, the Silk Road ^[21].

It was due to the Silk Road that the eastern Mediterranean became a major geographic medium for interaction between East and West from the 2nd century BCE till the Renaissance. The significance was largely economic, in carrying goods between the regions along the multibranched routes of the Silk Road, but of further significance was also the dissemination in both directions of ideas in religion and philosophy.

Traces of correspondence between *De architectura* and *Kao Gong Ji* could be thus due to two reasons, or more likely, their combination:

- Vitruvius was somehow, and quite unknowingly, in receipt of knowledge originating in an ancient source utilized in Chinese urbanist thought of the time.
- Similar geographic configurations of the north-eastern Mediterranean, such as latitude and the environment, on the one hand, and of the location of the Chinese source, on the other hand, had led to similar considerations for the founding and design of an ideal city.

While the affinity in *procedures* for the founding of an ideal city between the Chinese manual *Kao Gong Ji* and *De Architectura* is apparent, the radial-centric plan of Vitruvius, bounded by an octagonal perimeter, is radically different from the orthogonal plan in *Kao Gong Ji* referred to by Wheatley. Guiding the orthogonal plan of the Chinese ideal city in antiquity, to a greater or lesser extent, was the *Bagua*, a geomantic map of eight trigrams arranged in an octagon, and used as a divination device pointing to opportune directions and locations in geographic space ^[22-24].

Noticeable at first sight is the obvious similarity between the octagonal plan of the Tower of the Winds [Figure 3] and the *Bagua* geomantic map [Figure 4].

Andronicus' octagonal tower may have been also inspired by was the middle section of the Pharos Lighthouse off the coast of Alexandria, which was said to be octagonal as well ^[25,26]. Construction of the Pharos Lighthouse was completed c. 280 BCE, some two centuries before Andronicus. If a link between the *Bagua*, the Pharos Lighthouse and the Tower of the Winds could be proposed, Vitruvius' distinct reference to the Tower of the Winds as his inspiration would implicate the *Bagua* as possibly one of the sources to his own octagonal radial-centric plan. The *Bagua* and the Tower of the Winds could then be affirmed as intermediaries between the orthogonal plan described in the *Kao Gong Ji* and Vitruvius' octagonal radial-centric plan.

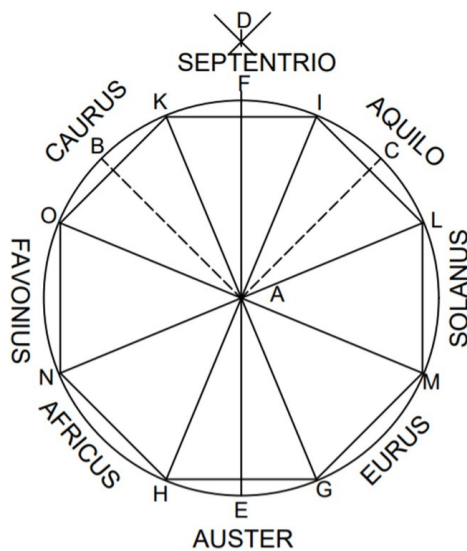


Figure 3. Vitruius, Apportioning city's circumference among the Eight Winds, after woodcut by Fra Giovanni Giocondo, 1511

The present study attempts to show that, indeed, a strong circumstantial evidence suggests that the ancient octagonal trigram map, specifically its version known as King Wen's "Later Heaven" *Bagua*, was likely transmitted from China as a geomantic concept during the first century BCE, inspiring the design of the Tower of the Winds.



Figure 4. The *Bagua* map, King Wen "Later Heaven" sequence

In its methodological framework, the research presented here ought to be seen as a case study in source criticism, whereby, as Howell and Prevenier observe ^[27], multiplicity of independent sources lending support to the same proposition, enhance the validity of that proposition. The proposition posited here, and referred to henceforth as Historical Hypothesis on the Tower of the Winds, is the claim that Andronicus' tower in Athens has an archaic Chinese source, primarily in the "Later Heaven" *Bagua*. The support for such a proposition, this study shows, can be sought in four observations that together constitute circumstantial evidence of high degree:

- The weathervane atop the Tower of the Winds is the first such device outside of China where it was first invented.
- The Tower of the Winds is due south of Athens' Acropolis, the city's most important site, while south is the most opportune direction in the ancient Chinese geomancy of *Feng shui*.
- Aligned to the south, the sequence of Greco-Roman wind-deities depicted on the frieze of the Tower of the Winds corresponds, almost exactly, to the sequence of the traditional Chinese winds as represented by the eight trigrams of the

geomantic map referred to as the “Later Heaven” *Bagua*.

- The design and configuration of the Tower of the Winds was by Andronicus of Cyrrhus, a city and a major trading port in the western portion of the Silk Road. Prior to arriving in Athens, Andronicus is known to have spent several years on the Mediterranean island of Tinos, possibly via Alexandria where he would have observed the Lighthouse of Pharos.

As detailed in the ensuing discussion all four observations are stand-alone propositions set apart of each other, yet jointly leading to a conclusion that suggests octagonal design of the *Bagua* as a source, possibly reinforced by Andronicus’ observation of the partial octagonal design of the Pharos Lighthouse. Though mutually independent, collectively the four propositions converge to the same strong possibility that the plan of the Tower of the Winds had a Chinese origin, which very likely was the “Later Heaven” *Bagua*, thus lending robust support to the Historical Hypothesis.

The proposition that the Tower of the Winds ought to be sourced to the *Bagua* as its origin has implication for the comparative urbanism involving Han China and early European urban planning. To be sure, actual cities laid out on an octagonal plan are found neither in ancient China nor in Roman Empire. But the apparent guidance Han designers sought in the *Bagua* for the plan of their ideal city, and the inspiration Vitruvius found in the Tower of the Winds for his own ideal city plan, enkindle tenets of urban design for pedestrian precincts within cities of our own times.

Indeed, comparative urbanism ought to be also carried onto the broader methodological framework that juxtaposes a historical original, against its counterpart in contemporary urban setting. Such an approach gives specific relevance and significance to the attention ancients on both sides of the known world afforded the consideration of wind directions. Contemporary efforts to optimize the

alignment, configuration and design of streetscapes ought to recognize the lasting message on the urban microclimate from the distant past.

Twentieth century’s car-centric urban planning and design had by and large bypassed forthright considerations of pedestrians in urban streetscapes, to the disquiet of a few lone urbanist critics of the time, their leading voice being Jane Jacobs [28]. The recent turnaround in urban design, redirecting attention to human gait and emphasizing out-of-the-door pedestrian movement in concert with the environment, ought to find an affirmative impulse in the urbanist work of the ancient Chinese planners, through inspiration of environmental considerations expressed in the *Bagua*, with a like impact also upon Andronicus and Vitruvius.

It is conceivable that the extant Chinese urban planning manual that is part of the *Kao Gong Ji*, is something of a culmination of archaic considerations and practices in the laying out of human settlements in early China. According to Nancy Shatzman Steinhardt [29], “excavation [...] from Neolithic China proves that sophisticated principles of urban planning were in operation long before the *Kao Gong Ji* or earlier texts were written [... A site at] Zhengzhou has yielded the most extensive evidence to date of a second millennium BCE walled city. [...] The plan of the Zhengzhou site published in 1954 shows that the Shang capital was nearly square, oriented to the south, and had a gate at each face.” Such practices would have carried, most likely, into the Iron Age of the Zhou, Qin and Han dynasties.

Both the Chinese and the Greco-Roman civilizations saw significance in wind directions. Microclimatic concerns implicit in aspects of the Han and Roman ideal city plans have been largely overlooked in contemporary urban design. Beyond ancient superstitions and religious notions about the environment, recognition ought to be given to the primeval acumen of careful observations and the methodical effort to

explain them, which had led to meaningful pursuit to configure built forms accordingly. In the Roman domain it was Andronicus and Vitruvius in their architectural and urbanist endeavour, who – similar to their Chinese forerunners – carried these considerations onto their figurative drawing boards, in an unwitting reception of environmental thought by the ancient authors of the *Bagua*.

3. TOWER OF THE WINDS: LINKING THE CHINESE *BAGUA* WITH VITRUVIUS' IDEAL CITY

It was from the center of a new town that Roman surveyors were laying out the main *cardo* avenue, forming the town's north-south axis, for conventional grid plan. Deviating from the grid convention, in his proposed ideal city Vitruvius does not advocate the construction of the *cardo*, but the town's centre is important for his radial-centric concept of streets. From the initial procedure for setting out the town's radius and some of its main radial axes, Vitruvius proceeds to identify directions of streets as a response to wind directions:

7. [...] From the four points thus obtained draw lines intersecting the centre from one side of the circumference to the other. Thus we shall have an eighth part of the circumference set out for Auster and another for Septentrio. The rest of the entire circumference is then to be divided into three equal parts on each side, and thus we have designed a figure equally apportioned among the eight winds. Then let the directions of your streets and alleys be laid down on the lines of division between the quarters of two winds [Figure 3].

Since both Greeks and Romans associated wind directions with minor deities, the weathervane on top of the Tower of the Winds was fulfilling a religious and community function. Lending support to the Historical Hypothesis is the fact that Andronicus' weathervane was also the very first known in the West.

The weathervane was invented in China at least a century before Andronicus. Referred to in Chinese as a "wind-observing fan" (*hou feng shan*) the weathervane was described in some detail in *Huainanzi*, a compendium on geography, mathematics, music, philosophy and religion dating to c. 139 BCE^[30]. The author-editor of the *Huainanzi* (*The Writings of the Huananzi Masters*) was Liu An (c. 179–122 BCE), a prince of the southern territory of Huainan and advisor to his nephew, the Han-dynasty Emperor Wu (r. 141–87 BCE).

A major collaborator of Prince Liu An on the *Huainanzi* was Dong Zhongshu (179–104 BCE), a philosopher and civil servant under the rule of Emperor Wu of Han. Dong Zhongshu was a commentator on the works of Kong Fuzi, known in the West as Confucius, a founding authority in Chinese philosophy and cultural tradition^[31]. Confucius (551 – 479 BCE) advocated harmony in society through strict hierarchy and conservative stratification in parallel to what he perceived as harmony in the cosmos^[32]. This was expressed in his commentaries on the archaic Chinese text, the *Yi Jing* (*I Ching*, or *Book of Changes*). According to Chinese tradition the *Yi Jing* was composed around 2000 BCE by the mythical king Fu Xi, but scholars date its core origins to c. 1000 BCE, with additional text added over perhaps five centuries^[33]. A major commentary on the *Yi Jing* is the book, *Ten Wings*, which according to tradition, though now disputed, was authored by Confucius. As a philosopher, Dong was the foremost authority of the time on the *Yi Jing* and the *Ten Wings*.

After a period of expressed hostility toward the thought of Confucius by the previous Qin dynasty (221–206 BC), the Han dynasty brought a major shift in the attitude towards Confucius. From the reign of Emperor Wu onward, the Han imperial court had become the official sponsor of Confucianism in education and court politics. This revival of old wisdom needed official justification in a synthesis with the Confucian cosmogony and religion. A

new stance of the imperial court adopted toward the Confucian philosophy led to the rise of Dong not only as a philosopher but also as government adviser.

In his capacity as a civil servant, Dong was promoting to Emperor Wu the establishment of Taixue, the imperial academy, where teaching of the *Yi Jing* would take place for the purpose of systematic recruitment of young civil servants through recommendations and written examinations. The Taixue imperial academy was established in 124 BCE by Emperor Wu, with Dong as its chancellor^[33].

An important topic under Dong's study, and a likely subject in the Taixue academy, was the *Ten Wings*, attributed to Confucius. This commentary on the canonical Chinese text, the *Yi Jing*, was divided into ten chapters, or Wings, each of the ten discussing a different topic. Sealing the *Ten Wings* are Chapters 8, 9, and 10 that address the subject of traditional Chinese hexagrams and trigrams, founded upon the cosmogonic notion of dichotomous opposites in the universe, the *yin* and *yang*. The *Yi Jing* presents the *yin* as a broken line, and the *yang* as a solid line. The Chinese hexagram in the *Yi Jing* comprises six stacked *yin-yang* combinations. All possible combinations of the dichotomous *yin-yang* configurations in groups of 6 yield exactly 64 unique hexagrams, 2^6 . The *Yi Jing* provides a religious, ethical and cosmogonic explanation to each hexagram, and to each *yin-yang* combination within a hexagram.

The 64 hexagrams of the *Yi Jing* are also pairwise permutations of eight trigrams, each trigram consisting of three stacked and distinct *yin-yang* combinations. Analogous to the hexagrams, all possible combinations of the *yin-yang* configurations, in groups of three, yield exactly 8 unique trigrams, 2^3 . Commentaries on the *yin-yang* and the trigrams were the subject matter of major parts of Dong's intellectual activity, and thus likely a subject under study at the Taixue.

The joint representation of all eight trigrams in an octagonal pictorial rendition is referred to as the *Bagua* map in the *Yi Jing*.

The *Bagua* map corresponds to the four main cardinal directions, and to the additional four sub-cardinals, with the *taiji* symbol of intertwined *yin-yang* being a much later addition. The *Yi Jing* gives interpretation to each trigram of the octagon as well as to each hexagram of the sixty-four. There is an obvious similarity between the octagonal *Bagua* map [Figure 4] and the plan of Andronicus' Tower of the Winds [Figure 5].

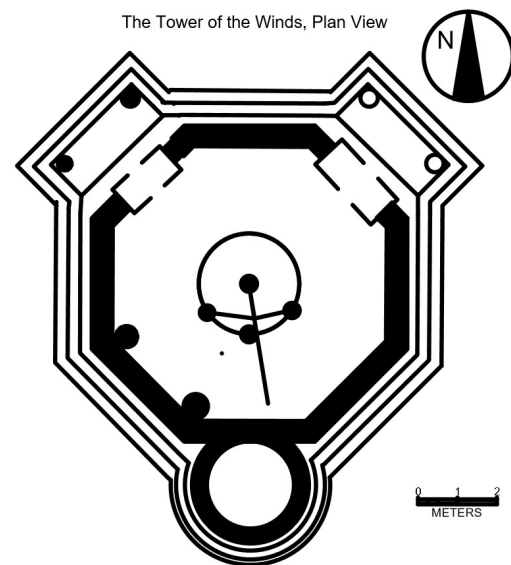


Figure 5. Andronicus of Cyrrhus, Tower of the Winds, plan

There are two sequences of the octagonal *Bagua* map, both sequences representing, among other things, wind directions. The first is the “Early Heaven” *Bagua* and the second is the “Later Heaven” *Bagua*. The two arrangements differ in the sequencing of their trigrams [Table 1]. The “Early Heaven” *Bagua* is traditionally attributed to Fu Xi, the mythical creator of humanity and of the *Yi Jing*. The *Ten Wings*, as most other commentaries, discuss however the “Later Heaven” *Bagua*, attributed to King Wen of Zhou (1112 – 1050 BCE). “Later Heaven” *Bagua* was also the subject of inquiry by Dong Zhongshu, who instituted the study of the *Yi Jing*, one of Five Confucian Classics, at the imperial academy, and it is thus safe to assume that it was the “Later Heaven” *Bagua* that became a subject of study at the Taixue^[34].

If transmission of the *Bagua* to the ancient Roman Republic had occurred, then it was most likely the “Later Heaven” sequence. Examining the Historical Hypothesis that the “Later Heaven” *Bagua* was transmitted to Andronicus, the similarity with the plan of the Tower of the Winds begs inspection of correspondence between the sequencing of the Greco-Roman religious reliefs of wind deities on the Tower of the Winds, and the sequencing of trigrams in the “Later Heaven” *Bagua* map.

The question whether the *Bagua* map could have possibly found its architectural rendition in Roman Athens, on the other side of the known world, thousands of kilometers away, is certainly related to the diffusion of many other ideas between China and the Greco-Roman civilization along the Silk Road.

The possibility of transformation of the *Bagua* into the plan of the Tower of the Winds may rest, specifically, in the location of the Taixue, on the one hand, and the likely residence of the young Andronicus, on the other hand. The Taixue academy was located in the Han capital city of Chang'an, “the largest, richest and grandest city in the world of that time”^[35]. It was also Chang'an that was to become home to “mostly the scholarly gentry class, their wealthy aristocratic families and their civil servants, [As a] cosmopolitan metropolis, the Han capital [...] was the political, economic, military and cultural center of China, the eastern terminus of the Silk Road”^[36]. The westernmost part of the Silk Road was where Cyrrhus was located [Figure 6].

4. THE SILK ROAD AND THE PROJECT OF ANDRONICUS OF CYRRHUS

As an ancient trade route, the Silk Road had been the foremost physical link between the two great civilizations of antiquity, China and Rome. Initially, the merchandise that was passed westward from China to the Roman Republic was mainly silk and porcelain, while wools and precious metals were carried in reverse course eastward to

China. Inevitably, not only material goods were transmitted in both directions, but ideas as well. Perhaps more than material goods, cross-fertilization of technological and spiritual ideas was the main force that contributed to the development and growth of China and Rome. Knowledge acquisition of manufacturing processes as well as scientific, philosophical and religious concepts were largely behind the progress of both civilizations.

Intermediate between the spiritual and the material domains of antiquity was ecclesiastical architecture and the urbanism of royal or holy cities. During the second and third century CE, a striking feature of ornamental concepts in early Christianity were depictions of celestial motifs on ceilings and particularly on the interiors of domes of religious buildings of the Eastern Roman Empire^[37]. Through multiple pieces of circumstantial evidence Alexander Soper had shown that this specific decorative feature was during the Middle Ages transmitted along the Silk Road into central Asia and further east to China, later spreading also to Korea and Japan:

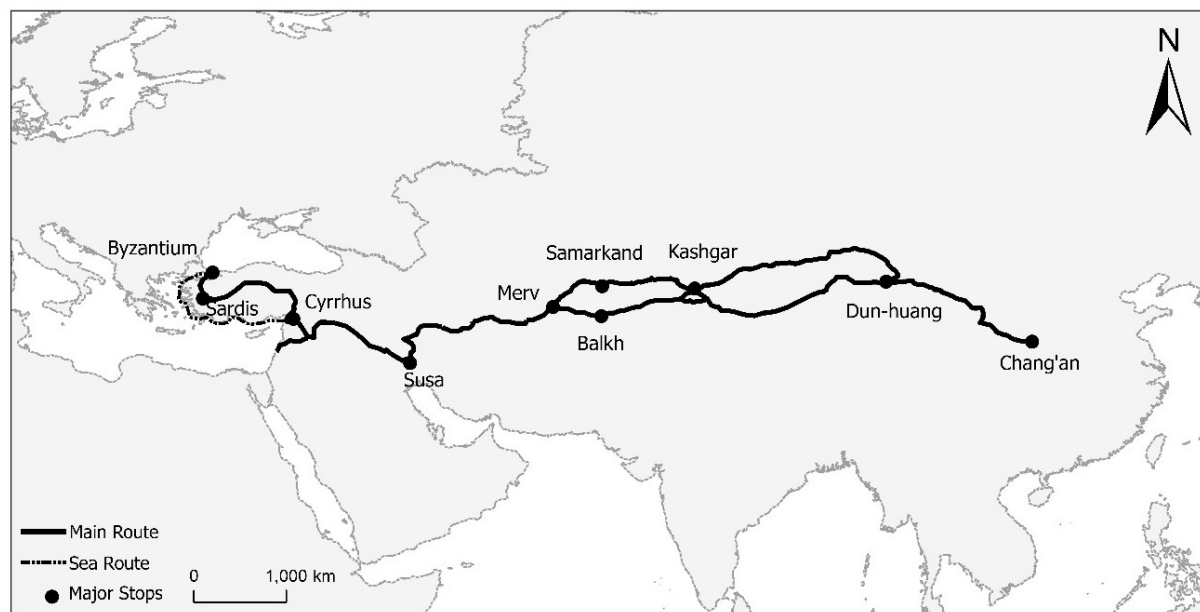
From around the beginning of the Christian era to well beyond the first millennium [...] and from India across Asia to the Pacific, a whole series of monuments of religious art and architecture reveals similarities to the Western tradition of celestial symbolism, which are hard to explain except by direct borrowing^[38].

Similar to Soper's argument, the present study too reasons through several pieces of circumstantial evidence. But in contrast to Soper, it shows that embryonic architectural and urbanist features, as expressed by the Tower of the Winds, point to a much earlier transmission through the Silk Road, and in the opposite direction: from China to western Asia, and beyond, to Athens of the Roman Republic.

Long-distance trade connection at the end of the rule of Emperor Liu Bang (r. 202–195 BCE), which later gave rise to the Silk

Table 1. Comparison of sequential arrangements in “Early Heaven” and “Later Heaven” *Bagua*

Direction	南 South		西南 Southwest		西 West		西北 Northwest	
<i>Bagua</i>	"Early"	"Later"	"Early"	"Later"	"Early"	"Later"	"Early"	"Later"
Trigram	乾 Qian	离 Li	巽 Xun	坤 K'un	坎 K'an	兑 Dui	艮 Gen	乾 Qian
Nature	天 Heaven	火 Fire	风 Wind	地 Earth	水 Water	泽 Lake	山 Mountain	天 Heaven
Direction	北 North		东北 Northeast		东 East		东南 Southeast	
<i>Bagua</i>	"Early"	"Later"	"Early"	"Later"	"Early"	"Later"	"Early"	"Later"
Trigram	坤 K'un	坎 K'an	震 Zhen	艮 Gen	离 Li	震 Zhen	兑 Dui	巽 Xun
Nature	地 Earth	水 Water	雷 Thunder	山 Mountain	火 Fire	雷 Thunder	泽 Lake	风 Wind

**Figure 6.** Silk Road, c. 50 BCE. Illustrated by Jingkun Shao.

Road, originated largely in Chang'an, at the time a metropolis of about 146,000 people^[39]. During the reign of Liu Bang's great-grandson, Emperor Wu (r. 141–87 BCE), Chang'an became the established point of departure of the Silk Road with the first mission sent to south-eastern Asia by Emperor Wu in 139 BCE. Gradually, as the Silk Road expanded to Central Asia Chang'an became an urban hub of conflation of people from different ethnic and religious backgrounds, with a trading post near the gate of the west city wall. As the Silk Road evolved into a multibranched transport corridor between China and Central Asia, it connected to an ancient Persian Royal Road at Susa, Persia, that had led since the early

sixth century BCE to the proximity of the eastern Mediterranean coast of Anatolia at Sardis, an ancient capital city of the kingdom of Lydia, incorporated in 546 BCE within the Persian Empire. Southeastern Europe thus became the westernmost region of interaction between East and West in antiquity. From the 2nd century BCE till modernity, the mutual impact between cultures along the Silk Road was largely affirmative to their economic, and cultural development, where also ideas in religion and philosophy found their way in both directions. Later in the early Renaissance, Chinese inventions in science and technology were instrumental in the early diffusion of woodblock printing as well as

the manufacture of porcelain throughout Europe.

Although there appears to be no explicit trace of Chinese impact upon European urban design, conspicuous is the octagonal, radial plan of the ideal city of Sforzinda [Figure 7] by the Florentine Renaissance architect Antonio Averlino Filarete (1400 – c.1469), described in his book *Libro architetonico*. Berthold Hub^[40] points out that

Filarete's designs show almost no similarities with the architecture of Rome; instead they share notable common features with the architecture of the Near and Far East, while the text situates the ideal city of Sforzinda in "India" [...] In Filarete's time the term *India* referred to a much larger geographical area than the present-day nation. China, for example, was at that time often designated "India."

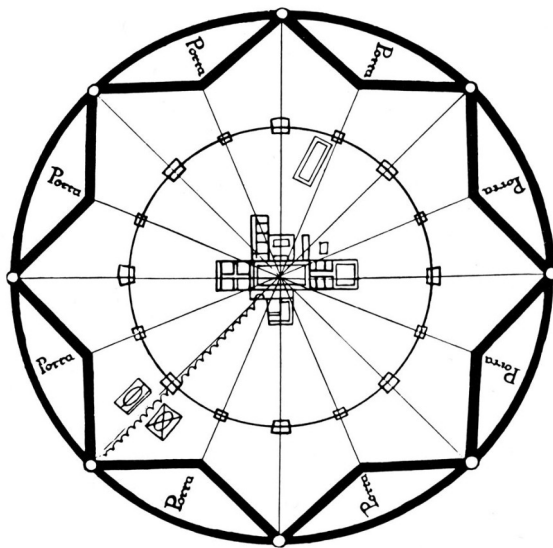


Figure 7. Filarete, Sforzinda, Plan, 1461

It is certain that ancient Chinese cities were not planned on octagonal pattern. Expediency in measurement, as well as cosmogonic belief in five founding elements of the universe, had guided a strict grid plan wherever topography allowed. The *Rites of Zhou*, a book on government bureaucracy includes in its sixth chapter, "Office of Winter," guidance as to the design of an

ideal city. Aligned to the cardinal directions, the layout of the ideal city ought to correspond to the Five Elements – wood, fire, earth, metal, and water – and the five planets as known to the ancient Chinese, thus yielding a square plan with the palace at its centre. All the same, Meyer^[41] notes, such ideal city plan "has never been actualized in all of Chinese history, although there have been some rather close approximations." As Meyer shows in the case of the ancient plan of Beijing, the *Bagua* has been the key conceptual instrument in the planning of gates, and continued to be so in the placement of important buildings or sites over the following two millennia. Similar to the Greco-Roman beliefs in opportune or adverse wind directions, so too, the eight *Bagua* trigrams, each symbolizing a compass direction as well as other geomantic attributes, is considered to signal good or bad fortunes.

It is conceivable that one or both versions of the *Bagua*, along with other religious notions adjoined with transported material goods, made their way through the Silk Road to the eastern Mediterranean. By then concepts, as well as merchandise, would no longer be transmitted by Chinese traders, but by Indian, Persian or other intermediaries. There were then possibly at least a few people in the Anatolia region of the eastern Mediterranean who encountered the concept of the *Bagua*. But it was the inquisitive mind of Andronicus, that carried the idea further – geographically and architecturally.

Andronicus, referred to in ancient sources with the suffix "Kyrresthes" came to Athens very likely as an adult, after a sojourn on the island of Tinos where he built a complex of sundials^[42]. There were three ancient communities in the eastern Mediterranean with the name of Cyrrhus or Cyrrha, one of them precisely on the western section of the Silk Road, in what was at the time of its founding, sometime after 300 BCE, the Seleucid Empire. The island of Tinos is about halfway between Athens and Cyrrhus of the Silk Road. Founded by

Seleucus Nicator, a former infantry general under Alexander the Great, and named after the Macedonian city of Cyrrhus, the Seleucid Cyrrhus came under brief Armenian control in 83 BCE, the approximate time of Andronicus' birth. In 64 BCE the city became a Roman jurisdiction following the capture of Antioch on the Orontes, the capital city of the Seleucid Empire, and the annexation of the entire region, turning it into a Roman province. It was possibly during the early life of Andronicus that Cyrrhus became also the capital of the district of Cyrrhastica^[43].

Cyrrhus (near today's town of Shengal, Syria) was Roman administrative and commercial center on the trade route between Antioch and the Euphrates River crossing at Zeugma, a city originally named Seleucia, also founded by Seleucus Nicator around the same time as Cyrrhus^[44]. Zeugma (near today's Gaziantep, Turkey) was approximately 80 km northwest of Cyrrhus, both cities of increasing importance to the Romans. Up to 70,000 people lived in Zeugma around the beginning of Civil Era, and its significance to the Romans was amplified due to the Silk Road passing through it^[45]. Somewhere near or within Zeugma, the Silk Road forked off, its eastern branch heading towards Sardis and Byzantium, and its southern branch merging with existing trade route leading to Antioch on the Orontes, evidently through Cyrrhus^[46,47].

Supporting the Historical Hypothesis is the acknowledged significance of Cyrrhus as a major trading post on the Silk Road that has been summed up by Millar^[48], thus:

[Antioch's] geographical, military, and economic location benefited its occupants, particularly such features as the spice trade, the Silk Road, and the Royal Road. It eventually rivaled Alexandria as the chief city of the Near East. The city was the capital of the Seleucid Empire until 63 BC [...] the existence of the Fertile Crescent meant that most traffic aiming for any point in the central Asian land-mass would leave

the Mediterranean coast in northern Syria [...] here there were the ports of Seleucia and Laodicea, and the inland cities of Antioch and Apamea, further up the Orontes; and further inland and to the north Cyrrhus [...] and to its south Beroea (Aleppo)[...]. These two places in fact defined the two main ways by which one might continue from Antioch to cross the Euphrates: either north-east through Cyrrhus to another Seleucia, usually known as Zeugma, 'the bridge,' and then into Mesopotamia, to reach Edessa [in Upper Mesopotamia]; or on eastwards through Beroea [...]

On this view, sometime before 50 BCE Andronicus left Cyrrhus for Athens, sojourning on the island of Tinos, where he built a renowned white marble sundial in the sanctuary of Poseidon and Amphitrite and came to be known as "famous for constructing astronomical instruments and inventing timepieces that were not only functional but beautiful – even marvelous"^[49]. At Athens, now within the Roman Republic, Andronicus designed his octagonal tower so that:

The lower level of the octagon is undecorated except for the markings for sundial on each face. In the upper level, personification of the winds, identified by inscriptions, are depicted in relief sculpture. The winds are represented as winged males who carry an attribute associated with the type of weather each one brings. All except Zephyrus, who is nude, are dressed in short tunic, billowing cloak, and boots. Four of the winds have beards to indicate adult status, while the remaining four are beardless youths. Boreas (north) blows into a conch shell to summon the group. Caecius (northeast) pours hailstones from a shield. Apeliotes (east) is young and carries grain and fruit in his cloak. Eurus (southeast) has his arm hidden in his cloak to summon a hurricane. Notus (south) is youth who pours rain out of a vase. Lips (southwest), also young,

leans on the stern of a boat and blows it on its way. Zephyrus (west), shown as a nude youth, scatters flowers. And Sciron (northwest) is an older man who empties a cauldron to signify the beginning of winter.

(Darling, 2004, p 216) ^[49]

The weathervane atop the Tower of the Winds, and the octagonal design itself of the tower, both give ground to the belief that Andronicus had absorbed ancient Chinese wisdom from Indian or Persian merchants and travelers passing through his hometown of Cyrrhus. On this view, the potential for architectural rendering of the *Bagua* likely occurred to Andronicus following his observation of the Pharos Lighthouse during a possible sojourn at Alexandria.

The indigenous use of the *Bagua* octagon in *Feng shui* was primarily in the location and alignment of buildings and interior spaces ^[50], but its place in the ancient Chinese notion of an ideal city plan has been widely accepted as well ^[24,51,52]. The evidence presented so far alludes to a likelihood that the *Bagua* played a role in the design of the Tower of the Winds. This, then, also reinforces the belief that the octagonal plan of the microclimate-conscious ideal city of Vitruvius, had been in fact indirectly inspired by the *Bagua*. To the extent that the *Bagua* represents also compass and wind directions, the impact of the *Bagua* upon the ancient Chinese ideal city was similar to the impact of the Tower of the Winds upon the ideal city plan of Vitruvius.

5. “LATER HEAVEN” *BAGUA*: FROM THE CHINESE IDEAL CITY TO VITRUVIUS

Ancient Chinese technical and manufacturing practices were recorded in the *Kao Gong Ji*, a part of Chapter Six, “Office of Winter,” in the *Rites of Zhou*. The title translates usually as *Records of Craftsman’s Examination*, and is dated, for most of its parts, to the early Warring States period, c. 475 BCE or shortly thereafter ^[53]. One of the last sections in the *Kao Gong Ji* deals with

civil engineering and town planning, and according to Guan and Herrmann, it was written more than two centuries later:

[...] the descriptions about the planning of cities have not been confirmed by excavation of cities from Chunqiu and Zhanguo periods. Therefore, this section was probably written only during the Qin dynasty (221–206 BCE) or the Western Han dynasty (206–24 BCE).

(Guan and Herrmann, 2014, p 15) ^[53]

Nonetheless, the urban planning part of the *Kao Gong Ji* could conceivably be a report on existing, or past, practices that set forth a procedure for the founding of a capital city, including its plan circumscribed by walls and ramparts. Schinz ^[39] and Sit ^[54] suggest that the planning guidelines in *Kao Gong Ji* reflect the actual founding and design c. 510 BCE of the city of Zhengzhou (near today’s Luoyang), the capital of the Zhou dynasty during the Eastern Zhou period (771 BCE – 256 BCE).

The *Kao Gong Ji* identifies the ideal city of the imperial capital as follows:

It is the sovereign alone who establishes the capital, gives the palace a central position and proper orientation to the four directions [...] Here, where Heaven and Earth are in perfect accord, where the four seasons come together, where the winds and rains gather, where the forces of *yin* and *yang* are harmonized, one builds a royal capital [...] a walled square. Each wall measures nine *li* (4,500m) and has three gates. There are nine north-south and nine east-west arterial roads, each of which shall have a width for accommodating nine chariot-ways [...]

(Sit, 2010, p 96) ^[54]

Within the square perimeter of the city, nine square subsections are subsumed by the nine roads and the nine gates, with the central square as the site of the palace designated as the imperial quarter. The top of the plan is in the south direction, as one that

is the most advantageous, yielding respective alignment to cardinal and sub-cardinal direction of each of the eight subsectional squares surrounding the central imperial square [Figure 8].

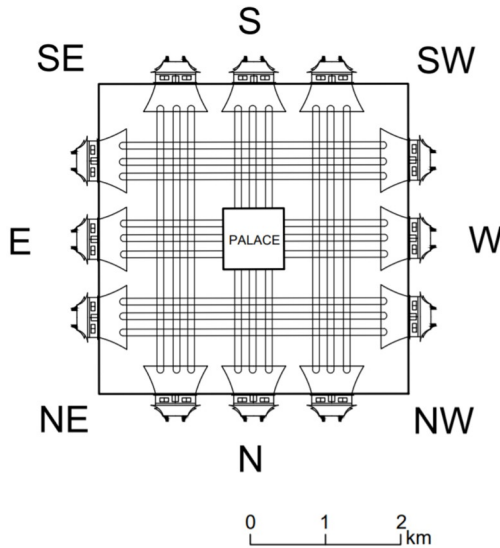


Figure 8. Plan of ideal capital city, after 17th century illumination of *Kao Gong Ji* ^[13]

According to an ancient legend, a mythical turtle had emerged from the raging Luo River with a mysterious pattern on its shell: circular dots representing the integers 1 through 9, arranged in a square three-by-three grid [Figure 9]. The *Luo Shu* pattern of the square grid, transformed into a table of corresponding integers, yields what is known in mathematics as magic square of order 3 [Figure 10]. A magic square has sums of entries in each column and in each row, as well as sums of entries on each diagonal, add up to exactly the same number. In the case of the *Luo Shu* Square the sum is 15, the number of days in the 24 solar terms of the Chinese year. Viewing the *Luo Shu* Square as having its largest integer in the pattern, 9, pointing to South, the most advantageous direction, results in the lowest integer in the pattern, 1, pointing to North, the least desirable direction. In the interpretation of Alfred Schinz, based on commentaries on the *Kao Gong Ji* by the philosopher Zheng Xuan (127–200 CE), the *Luo Shu* Square becomes the guide to the plan of the Emperor's city

with the number 5 at its centre, associated with the Emperor while representing also the Five Elements ^[39]. From this viewpoint, too, the *Luo Shu* Square constitutes a ritual feature associated with the ideal city ^[55].

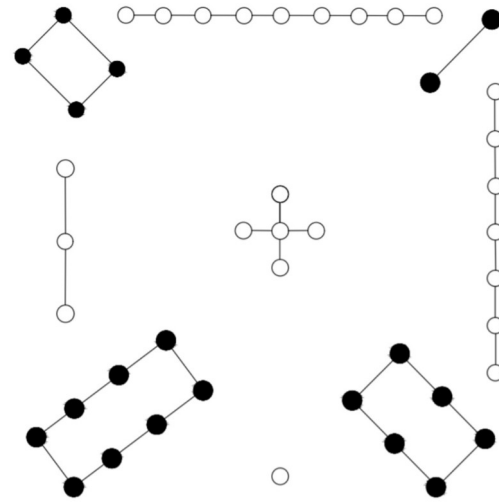


Figure 9. *Luo Shu* diagram, first millennium, BCE

The perimeter numbers of the *Luo Shu* square show one-to-one correspondence with the eight trigrams as evident from Figure 10 and Table 2. This correspondence yields a set of four pairs of mutual opposites as noted by Schuyler Cammann ^[56]:

In Old Chinese tradition the Lo-shu, being square in shape, was a symbol of the square Earth; while the circle of [...] trigrams, complementing it, represented the round Sky or Heaven. Being associated together, individual trigrams in the circle complemented opposing numbers on the Lo-shu, so each pair of numbers from the two diagrams would equal 10.

In its eight trigrams, each representing, among other things, the eight cardinal and sub-cardinal directions from which the eight winds blow, the “Later Heaven” *Bagua* map is a symbolism akin to that found in the Tower of the Winds. The arrangement of wind directions on the friezes of the Tower of the Winds corresponds, almost identically, to the arrangement of trigrams in the “Later

SE		S		SW
	4	9	2	
E	3	5	7	W
	8	1	6	
NE		N		NW

Figure 10. Numeric transliteration of the *Luo Shu* diagram into magic square

Table 2. Chinese and Greco-Roman wind-names with corresponding *Luo Shu* magic square numbers

King Wen "Later Heaven" <i>Bagua</i> arrangement						Tower of the Winds frieze	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Luo Shu	Name	Nature	Season	Direction	Chinese wind names	Greek wind gods	Roman gods
9	离 Li	火 Fire	Summer	南 South	景 风 Jing	Notus (South)	Auster
2	坤 Kun	地 Earth	Summer	西南 Southwest	凉 风 Liang	Lips (Southwest)	Africus
7	兑 Dui	泽 Lake	Autumn	西 West	鬲 鬲风 Chang He	Zephyrus (West)	Favonius
6	乾 Qian	天 Heaven	Autumn	西北 Northwest	不周风 Bu Zhou	Skiron (Northwest)	Corus
1	坎 Kan	水 Water	Winter	北 North	广莫风 Guang Mo	Boreas (North)	Aquilo
8	艮 Gen	山 Mountain	Winter	东北 Northeast	融 风 Rong	Kaikias (Northeast)	Caecius
3	震 Zhen	雷 Thunder	Spring	东 East	明庶风 Ming Shu	Apeliotes (East or SE)	Subsolanus
4	巽 Xun	风 Wind	Spring	东南 Southeast	清明风 Qing Ming	Eurus (Southeast or E)	Vulturnus

Heaven" *Bagua*. Consistent with the Historical Hypothesis presented earlier, then, the sequence of trigrams representing winds, is almost identical to the sequence of wind deities on frieze of the Tower of the Winds. The basic meanings of the eight trigrams and their corresponding winds, along with the corresponding *Luo Shu* Square numbers, and the corresponding Tower of the Winds frieze deities, are as follows:

- 9· 离 Li represents the south and it symbolizes Fire epitomizing expansion, illumination and shining as a bright flame. The wind from south is Jing, the hot heavy wind bringing storms, and marking summer solstice. It corresponds with the Greek Notus.

- 2· 坤 Kun represents the southwest and it symbolizes Earth exemplifying receptive, nurturing, and supportive mother earth. The wind from southwest is Liang, a chilly wind, standing for the beginning of fall. It corresponds with the Greek Lips.

- 7· 兑 Dui represents the west and it symbolizes Lake expressing joy, happiness, and pleasure in the world. The wind from west is Chang He and it marks the Fall Equinox. It corresponds with the Greek Zephyrus.

- 6· 乾 Qian represents the northwest and it symbolizes Heaven displaying perfection, strength and the creative power of the universe. The wind from northwest is Bu Zhou, and with nature becoming withered, it

stands for the start of winter. It corresponds with the Greek Skiron.

- 1·坎 Kan represents the north and it symbolizes Water nourishing and moistening things in the universe. The wind from north is Guang Mo, the coldest of all winds, representing winter solstice, and it corresponds with the Greek wind god Boreas.

- 8·艮 Gen represents the northeast and it symbolizes Mountain holding good luck and embodying stillness. The wind from northeast is Rong, melting cold ice, and constituting the transition from winter to spring, standing for start of spring. It corresponds with the Greek Kaikias.

- 3·震 Zhen represents the east and it symbolizes Thunder, for dynamic movement, new birth and growth. The wind from east is Ming Shu, the gentlest of all winds bringing vitality to the world, and marking the Vernal Equinox. It corresponds with the Greek Apeliotes.

- 4·巽 Xun represents the southeast and it symbolizes Wind gathering prosperity and then dispersing it throughout people's lives. The wind from southeast is Qing Ming, and it marks the start of summer. It corresponds with the Greek Eurus.

The taiji symbol of the intertwined yin-yang, as in Figure 4, corresponding to *Luo Shu* centre number, 5, had been introduced much later than the trigrams, in the fourteenth century CE ^[57]. Since each trigram in the "Later Heaven" *Bagua* also corresponds to a unique number in the *Luo Shu* Square, there is also indirect correspondence between the plan of the ideal city in the *Kao Gong Ji* and the plan of the Tower of the Winds [Table 2]. Noteworthy is Vitruvius' reference to "the numbers and names of the wind" (Book I, 6:5) on the tower reliefs, which may suggest that names as well as numbers were originally carved on the friezes alongside the depicted wind gods.

Furthermore, the Acropolis, Athens' most important site, is exactly to the south of the Tower of the Winds. This is likely not a coincidence, but rather evidence that Andronicus aligned his project according to

the *Bagua* practice. The "Later Heaven" *Bagua* and the Tower of the Winds become thus the joint intermediaries – inadvertent perhaps – for impact, hardly deniable, of ancient Chinese ideal-city plan, upon early European urban design as represented by the *Bagua*, on the one hand, and by the Vitruvian ideal city, on the other hand.

6. CONCLUSION: THE SILK ROAD AND EARLY EUROPEAN URBAN PLANNING

Vitruvius' *De architectura* is considered the foremost literary source of the Greco-Roman classical tradition that is at the founding of European urbanism. It is, however, very likely that other literary documents on architecture and urbanism were produced at the time but did not survive the turmoil and tribulations of the Middle Ages. Over three hundred years before Vitruvius, Aristotle in the *Politics* ^[58] discussed streetscapes as an aesthetic and defensive element of city planning. It is conceivable that in the three centuries between Aristotle and Vitruvius other urbanist accounts were written, and subsequently lost during the Middle Ages. There exist, therefore, gaps in our knowledge on the origins of western urbanism.

This study has attempted to address one of these gaps by tracing a significant connection, conjectured to have existed between the ancient Chinese geomancy of the *Bagua* and the origins of early European urban planning in *De architectura*. The ideal city in *De architectura* draws on the plan of the Tower of the Winds, where the sequence of Greek wind gods depicted on the frieze, matches almost exactly the sequence of Chinese wind directions in both arrangements of the *Bagua* map, a founding element of the *Feng shui*. There had been possibly only one structure disposed on an octagonal plan, built prior to the Tower of the Winds: This was the middle section of the Pharos Lighthouse of Alexandria. Andronicus had very likely observed the Pharos, which ultimately inspired the plan of his own tower, some two centuries after the Pharos was built. But in contrast to the

Lighthouse, Andronicus' tower is aligned to the south, very much like both the "Early -" and the "Later Heaven" *Bagua*, and the alignment is almost straight south toward the Acropolis, the most important place in Athens. It is unlikely that such configuration was coincidental. Due to precession of the equinoxes, it is fair to assume that two millennia ago the Acropolis was exactly due south of the Tower of the Winds. Along with the Chinese invention of the weathervane atop the Tower of the Winds, the octagon in Andronicus' design gives reason to the belief that the tower was a hybrid product synthesizing Greek and Chinese concerns for wind directions.

According to the Historical Hypothesis it was the "Later Heaven" version of the *Bagua* that was taught at the Taixue at Chang'an and the one that Andronicus encountered. The "Later Heaven" *Bagua*, thus, emerges as an idea transmitted through the Silk Road during the first century BCE, and adapted into architectural notion by Andronicus^[59], most likely, upon his observation of the octagonal middle section of the Pharos Lighthouse.

Since its founding in 139 BCE until early modernity of the fifteenth century, the Silk Road had become a network of trade routes which connected China to central and western Asia, and to the eastern Mediterranean, distance of over 7,000 km. Recognized for the economic, cultural, political, and religious interactions between East and West the Silk Road brought many Chinese scientific and technological improvements, or entirely new ideas, to Europe, helping to pave the way to modernity's scientific and industrial revolutions.

Affirmative influence upon cultures, undoubtedly, went in both directions between the East and the West. But the impact of ancient China on European civilization has been acknowledged to be multifold and varied. The significant inventions carried from China to Europe over the centuries had included the magnetic compass, gunpowder, papermaking and

printing, porcelain, and silk^[60]. Among significant Chinese ideas absorbed in Europe were farming techniques, iron and copper metallurgy and exploitation of coal and petroleum^[61].

On the other hand, the magic square had arrived in European mathematics only in the late Middle Ages in the works of Arzachel (1029 – 1087) and Abraham Ibn Ezra (1089 – 1164), both of Toledo^[62,63], and there is no direct evidence that China transmitted the idea westward. Yet the imprint of the *Luo Shu* magic square diagram appears as an implicit urbanist notion of Han China: "Architectural emphasis [in the *Kao Gong Ji*] on a directionally oriented square, a nine-part division of the city's space, and the association of centrality with authority are reminiscent of the *Luo Shu*"^[52].

Application of the *Luo Shu* magic square diagram in the Chinese ideal city plan, as suggested by Swetz^[52] and Schinz^[39], implicates further the "Later Heaven" *Bagua*, as a tacit urbanist notion of Han China. Notwithstanding its urbanist connection in ancient China, the *Bagua*, transmitted, transmuted, and metamorphosed in the Tower of the Winds, found its way through Vitruvian ideal city, to become a hidden, unrecognized voice also in early European urban planning.

The European notion of the ideal city had been put forward already by Plato during the third century BCE in the philosophical accounts of Atlantis and Magnesia in his dialogues *Critias* and *Laws*^[64], and urban planning had been recognized as an important discipline since at least the time of Hippodamus (498 – 408 BCE). The significance of wind direction in site selection had been put forward in Hippocrates' book c. 400 BCE (*ibid.*). But actual street configuration in an ideal city considering wind currents occurs for the first time in Vitruvius where, as this study shows, the "Later Heaven" *Bagua* had been a critical, albeit unknown or unacknowledged source.

As a divination concept of ancient Chinese tradition, the *Bagua*, was believed to

confer a mythical power on wind currents in much the same way as the Greco-Roman religion did. Andronicus and Vitruvius had transformed this belief in mythical power onto an architectural and urbanist consideration. Following on his previous account on the founding of a city in Book I, Vitruvius turns to streetscape design in Chapter Six, “The Directions of the Streets: With Remarks on the Winds”:

8. On this principle of arrangement the disagreeable forces of the winds will be shut out from dwellings and lines of houses. For if the streets run full in the face of the winds, their constant blasts rushing in from the open country, and then confined by narrow alleys, will sweep through them with great violence. The lines of houses must therefore be directed away from the quarters from which the winds blow, so that as they come in they may strike against the angles of the blocks and their force thus be broken and dispersed.

The resulting octagonal geometry of the Vitruvian ideal city, thus, bears witness to the primal recognition that the Greco-Roman religion conferred on microclimate. By way of the *Bagua* the same ought to be said about the ancient Chinese divination.

The lasting recognition of these considerations is attested by the architectural and urbanist revival of the Renaissance. During the Renaissance, Vitruvius’ concern for wind direction in the design and direction of streets had been echoed in *The Four Books of Architecture* by Andrea Palladio who wrote:

[...] when laying out streets one must ensure very carefully (as Vitruvius teaches us in Book I, chapter 6) that they do not follow the direction of any wind so that one does not suffer furious and violent gusts along them but the winds are dispersed, mollified,, weakened and enfeebled, contributing to the greater healthiness of the inhabitants; one should avoid the mistake made by those who, in ancient

times, laid out the streets of Mytilene on the island of Lesbos.

(Palladio, 1570/1997, p 166) ^[65]

Continual attention to winds in urban architecture from late antiquity to seventeenth century has been discussed by Alessandro Nova in his chapter, “The role of the winds in architectural theory from Vitruvius to Scamozzi” ^[66]. During the Renaissance, in particular, walled defense of cities is mentioned in one breath with urban street alignment “for protection of wind” in Book II of Thomas More’s *Utopia* or in di Giorgio Martini’s *Trattati di architettura ingegneria e arte militare* ^[67,68].

In architecture, octagonal plan aligned to the eight compass directions, after small correction due to precession of the equinoxes, is recognizable in the Lateran Baptistery in Rome (c. 440 CE), in the Basilica of San Vitale in Ravenna (548 CE) and in the Florentine Baptistery of San Giovanni (built during 1059–1128), the latter conspicuously similar in overall design to the Tower of the Winds. Vitruvius’ octagonal ideal-city plan had been ignored in actual planning until the early Renaissance in Italy, where its traces are evident in several ideal-city concepts of that period. Most prominent of these is *The Ideal City* painting from c. 1480 attributed to Fra Carnevale, now in the Walters Art Museum, Baltimore. During the Baroque, remnants of octagonal design in Christopher Wren’s Plan for London of 1666 can easily be detected, evidently instilled by Vitruvius and Andronicus.

An eminent architect, as well as a distinguished scientist and astronomer, in 1676 Sir Christopher also designed the building, prominent through its octagonal feature, that came to house the Royal Astronomical Observatory at Greenwich, near London. Andronicus’ hybridizing brilliance had been further commemorated by Oxford University when it built in 1773 its own astronomical octagon station, the Radcliffe Observatory, inspired by the Tower of the Winds [Figure 11].

Similar to the fate of Vitruvius' ideal city, which had to wait for a comeback till the Renaissance, in the opinion of some, the emperor's city plan in *Kao Gong Ji* was truly enacted also only about the same time, at the end of the Middle-Ages. According to Wu Luoyang, a leading scholar in the history of ancient Chinese architecture, the first city that genuinely followed the plan outlined in *Kao Gong Ji* was built only in the thirteenth century CE, when the winter capital Dadu was founded by the Mongol ruler of China, Kublai Khan, in what is now Beijing^[69].



Figure 11. Radcliffe Observatory, Oxford. Photo by Craig Webber. Licensed under Creative Commons Attribution 3.0 Unported. Source: https://commons.wikimedia.org/wiki/File:Green_Templeton_College.jpg

The underlying environmental tenet of ideal cities in the *Kao Gong Ji* and in *De Architectura* has been awaiting, as well, recognition for a long time to come. As pertinent today as two millennia ago, antiquity's environmental wisdom is a germane reminder that facilitation of

amicable pedestrian movement in cities is subject to some timeless precepts. The age-old concern with urban microclimate in streetscape design remains a lasting challenge to planning for pedestrian-friendly urban precincts. Beyond the outward superstition of archaic times, the substance of urbanist reasoning in ancient China and in the Greco-Roman architectural tradition, is vested in the careful observation of the urban microclimate, and in human ingenuity to shape built environments accordingly. In their consideration of wind currents in street design for humans, the joint message of the *Bagua* author, the ancient Chinese city builders and the Greco-Roman duo of architects, thus becomes a lasting legacy of antiquity's urbanist thought.

CONFLICT OF INTEREST

None of the authors have any competing financial, professional, or personal interests from any other parties.

ACKNOWLEDGMENTS

We are indebted to the Editor and to two anonymous referees of this journal for their insightful observations, valuable comments and constructive criticism on the previous versions of this study.

FUNDING

This work was financially supported by the University of Saskatchewan Sabbatical Grant (2019) awarded to A.A.

AUTHOR CONTRIBUTIONS

A.A. conceived of the study and was responsible for its format and content. J.S. was responsible for historical data collection and presentation, and for the artwork. A.A. wrote the article presented here, J.S. assisted in writing, reviewed and approved previous draft and the article presented here. Both A.A. and J.S. are members of the Department of Geography and Planning, University of Saskatchewan. A.A. is professor and supervisor of J.S., a graduate student.

REFERENCES AND NOTES

- [1] Vitruvius Polio M. The ten books on architecture, translated by Morris Hicky Morgan. c. 30 BCE/1960, Dover, New York.
- [2] Rosenau H. The ideal city: Its architectural evolution in Europe. 2013, Routledge, London and New York.
- [3] Lagopoulos AP. The semiotics of the Vitruvian city [J]. *Semiotica*, 2009, 175(1): 193-251.
- [4] Cache B. The Tower of the Winds of Andronikos of Kyrros [J]. *Architectural Theory Review*, 2009, 14(1): 3-18.
- [5] Nichols MF. Author and audience in Vitruvius' *De architectura*. 2017, Cambridge University Press, Cambridge and New York.
- [6] Giocondo FG. M. Vitruvio, *De Architectura libri decem additis*. 1511, Giovanni Tacuino, Venice.
- [7] Hippocrates. *Airs, waters, and places*. 400 BCE/1881, Wyman and Sons, London.
- [8] Stuart J, Revett N. The antiquities of Athens measured and delineated by James Stuart F.R.S. and F.S.A. and Nicholas Revett Painters and Architects, Vol. III (ed. Willey Reveley). 1794, John Nichols, London.
- [9] Laurence R. *Roman Pompeii: Space and society*. 2006, Routledge, London and New York.
- [10] Castleden R. *The Mycenaeans*. 2005, Taylor & Francis, Abingdon.
- [11] Hill JD. The Pre-Roman Iron Age in Britain and Ireland (ca. 800 B.C. to A.D. 100): An overview [J]. *Journal of World Prehistory*, 1995, 9(1): 47-98.
- [12] Stoddart S, Palmisano A, Redhouse D, et al. Patterns in Etruscan urbanism [J]. *Frontiers in Digital Humanities*, 2020, 7: 1-30.
<https://doi.org/10.3389/fdigh.2020.00001>
- [13] Wenren J. Ancient Chinese encyclopedia of technology: Translation and annotation of the *Kaogong ji* (the artificer's record). 2013, Routledge, London and New York.
- [14] Wright, AF. Reflections on Chang'an and other great cities [J]. *Journal of Asian Studies*, 1965, 24(4): 667-679.
- [15] Wheatley P. The ancient Chinese city as a cosmological symbol [J] *Ekistics*, 1975, 39(232): 147-158.
- [16] Whitehouse OC. *The Book of the Prophet Ezekiel*. 1902, J.M. Dent, London.
- [17] Beale, GK. *The Book of Revelation*. 1999, Eerdmans Publishing Company, Grand Rapids, MI.
- [18] Drinkard JF. Jr. "Ezekiel," in: Watson Mills (ed.), *The Prophets: Mercer Commentary on the Bible*, Volume 4. 1996, Mercer University Press, Macon, 159-203.
- [19] Hsu E. Wind, life, health: Anthropological and historical perspectives [J]. *Journal of the Royal Anthropological Institute*, 2007, 13: S117-S134.
- [20] Charles RH. *A Critical and Exegetical Commentary on the Revelation of St. John*, Part 2. 1920, Charles Scribner's Sons, New York.
- [21] Stuckenbruck LT. "Revelation," in: James D. G. Dunn and John William Rogerson (eds.), *Eerdmans Commentary on the Bible*. 2003, William Eerdmans, Grand Rapids, MI, 1535-1572.
- [22] Madeddu M, Zhang X. Harmonious spaces: the influence of *Feng Shui* on urban form and design [J]. *Journal of Urban Design*, 2017, 22(6): 709-725.
- [23] Wright AF. "The Cosmology of the Chinese City," in: William G. Skinner (ed.), *The City in Late Imperial China*. 1977, Stanford University Press, Stanford, 33-75.
- [24] Zhang D. Cultural symbols in Chinese architecture [J]. *Architecture and Design Review*, 2019, 1(1): 1-17
- [25] Heinle E, Fritz L. *Towers: A historical survey*. 1988, Rizzoli, New York.

- [26] Clayton PA. Seven wonders of the ancient world. 2013, Routledge, London and New York.
- [27] Howell MC, Prevenier W. From reliable sources: An introduction to historical methods. 2001, Cornell University Press, Ithaca and London.
- [28] Jacobs J. Death and life of great American cities. 1961, Random House, New York.
- [29] Steinhardt NS. Chinese imperial city planning. 1990, University of Hawaii Press, Honolulu.
- [30] Vankeerberghen G. The *Huainanzi* and *Liu An's* Claim to Moral Authority. 2001, SUNY Press, Albany.
- [31] Lowe M. "The former Han dynasty," in Denis Twitchett and Michael Lowe (eds.), The Cambridge history of China, vol.1, The Ch'in and Han Empires 221 B.C-A.D. 220. 1986, Cambridge University Press, Cambridge and New York, 103-222.
- [32] Lowe M. "The concept of sovereignty," in Denis Twitchett and Michael Lowe (eds.), The Cambridge History of China, vol. 1, The Ch'in and Han Empires 221 B.C-A.D. 220. 1986, Cambridge University Press, Cambridge and New York, 726-743.
- [33] Nylan M. The five "Confucian" classics. 2001, Yale University Press, New Haven and London.
- [34] Nielsen B. Cycles and sequences of the Eight Trigrams [J]. Journal of Chinese Philosophy, 2014, 41(1-2): 130-147.
- [35] Boyd A. Chinese architecture and town planning, 1500 B.C.-A.D. 1911. 1962, Alec Tiranti, London.
- [36] Zhang G, Wang L. Urban planning and development in China and other East Asian countries. 2019, Tongji University Press, Shanghai; Springer, New York.
- [37] Lehmann K. The dome of heaven [J]. The Art Bulletin, 1945, 27(1): 1-27.
- [38] Soper AC. The "Dome of Heaven" in Asia [J]. The Art Bulletin, 1947, 29(4): 225-248.
- [39] Schinz A. The magic square: Cities in ancient China. 1996, Edition Axel Menges, Stuttgart.
- [40] Hub B. Filarete and the East: The Renaissance of a *Prisca Architectura* [J]. Journal of the Society of Architectural Historians, 2011, 70(1): 18-37.
- [41] Meyer JF. "Feng-Shui" of the Chinese city [J]. History of Religions, 1978, 18(2): 138-155.
- [42] Theodossiou E, Petros M, Vassilios NM. The quadruplex Sundial of Tenos [J]. The Compendium, 2006, 13(2): 27-30.
- [43] Edmond F. Une nouvelle inscription latine à Cyrrhus (Syrie du Nord) [J]. Mélanges de l'école française de Rome, 1994, 106(1): 71-77.
- [44] Comfort A. Roman bridges of South-East Anatolia [J]. Collection de l'Institut des Sciences et Techniques de l'Antiquité, 2013, 1277(2): 315-342.
- [45] Young GK. Rome's Eastern Trade: International Commerce and Imperial Policy 31 BC – AD 305. 2001, Routledge, London and New York.
- [46] Kevin B. Coinage in Roman Syria: Northern Syria, 64 BC-AD 253. 2004, Royal Numismatic Society, London.
- [47] Comfort A. "Traveling between Euphrates and Tigris in Late Antiquity," in: Anne Kolb (ed.), Roman Roads: New Evidence - New Perspectives. 2019, De Gruyter, Berlin and Boston, 109-131.
- [48] Millar F. Caravan Cities: The Roman Near East and long-distance trade by land [J]. Bulletin of the Institute of Classical Studies, 1998, 42(Supp 71): 119-137.
- [49] Darling JK. *Architecture of Greece*. 2004, Greenwood Press, Westport, CT and London.
- [50] Chiou S-C, Krishnamourti R. Unraveling *Feng-shui* [J]. Environment and Planning B: Planning and Design, 1997, 24: 549-572.
- [51] Xu Y. The Chinese city in space and time: The development of urban form in

- Suzhou. 2000, University of Hawaii Press, Honolulu.
- [52] Swetz F. Legacy of the *Luoshu*: The 4,000 year search for the meaning of the magic square of order three. 2008, CRC Press, Boca Raton.
- [53] Guan Z, Herrmann K. *Kao Gong Ji*: The world's oldest encyclopaedia of technologies. 2014, Brill.
- [54] Sit VFS. Chinese city and urbanism: Evolution and development. 2010, World Scientific, London and Shanghai.
- [55] Rykwert J. The idea of a town: The anthropology of urban form in Rome, Italy and the ancient world. 1988, MIT Press, Cambridge, MA.
- [56] Cammann S. Chinese hexagrams, trigrams, and the binary system [J]. Proceedings of the American Philosophical Society, 1991, 135(4): 576-589.
- [57] Louis F. The genesis of an icon: The "Taiji" diagram's early history [J]. Harvard Journal of Asiatic Studies, 2003, 63(1): 145-196.
- [58] Jowett B. Aristotle's Politics, with an introduction by Max Lerner. 1943, Modern Library, New York.
- [59] Akkerman A, Shao J. "The Impact of Chinese Geomancy on Early European Urban Planning," Colloquium, Jan 16, 2020: Classical, Medieval and Renaissance Studies, University of Saskatchewan, Saskatoon.
- [60] Fara P. Science: A four thousand year history. 2009, Oxford University Press, Oxford and New York.
- [61] Millward JA. The Silk Road: A very short introduction. 2013, Oxford University Press, Oxford and New York.
- [62] Comes R. "The transmission of Azarquiel's Magic Squares in Europe," in: Faith Wallis and Robert Wisnovsky (eds.), Medieval Textual Cultures: Agents of Transmission, Translation and Transformation. 2016, De Gruyter, Berlin and Boston, 159-198.
- [63] Berglund L. The secret of *Luo Shu*: Numerology in Chinese art and architecture. 1990, Tryckbiten, Lund, Sweden.
- [64] Golding NH. Plato as a city planner [J]. Arethusa, 1975, 8: 359-371.
- [65] Palladio A. The four books of architecture, translated by Robert Tavernor and Richard Schofield. 1570/1997, MIT Press, Cambridge, MA.
- [66] Nova A. The role of the winds in architectural theory from Vitruvius to Scamozzi, in: Barbara Kenda (ed.), Aeolian winds and the spirit in Renaissance architecture: Academia Eolia revisited. 2006, Routledge, London, 70-86.
- [67] More St T. Utopia, edited by George M. Logan and Robert M. Adams. 1516/1989, Cambridge University Press, Cambridge.
- [68] Friedman D. Florentine new towns. 1988, MIT, Cambridge, MA.
- [69] Wu L. A brief history of ancient Chinese city planning. 1986, Gesamthochschulbibliothek, Kassel.